

GREAT TRANSPORTATION AREAS OF THE UNITED STATES.

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ALL general questions relating to transportation must of necessity involve, amongst other things, the elements relating to the distribution of population, the location of the lines of least resistance, the character of the traffic, the distance to the market or *market-range* and the total cost of movement.

The latter item may be taken as the measure of most of the others. It is composed of a large number of variables, which for practical purposes have been reduced to a rate per unit of distance and of weight, whether by water or by rail.

A comparison of these units becomes therefore of great importance, as a basis for determining the limits of territory tributary to any particular route. Such a comparison was recently prepared,* showing the

RELATIVE RATES ON GRAIN IN BULK FROM CHICAGO
TO LIVERPOOL.

RATE PER TON PER MILE IN MILLS.	RELATIVE RATES.	RELATIVE DISTANCES.	RELATIVE TRIBUTARY AREAS.	RELATIVE BENEFITS.
By Railroad 5.08	6.6	3	9	1
" Canal 3.04	4.	5	25	2.8
" Lake or River . 1.57	2.	10	100	11.1
" Lake and Canal . 2.00	2.6			
" Ocean 0.77	1.	20	400	44.4

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7A

From this table it would appear that, other things being equal, at canal rates the area benefited would be 2.8 times that at rail rates; at lake or river rates it would be 11 times, and at ocean rates 44 times greater, thus showing the superiority of movement in bulk with a minimum of fixed expense and low percentage of terminal charges.

It also exhibits clearly the fact that the cost of movement by water, whether in contracted natural or artificial channels, or upon the broad ocean, is much less than that by rail. Thus the overland rate is 1.6 times that by canal, 3.3 times that by river or lake and 6.6 that by ocean. There can be no doubt, therefore, that where it does not involve too many handlings or delays, it is desirable to ship when practicable by the ocean route.

Under the above conditions, the waterway must be regarded as the natural channel and the railroad as the feeder; but since the first must be used in its natural bed, the second has the great advantage of shortness and speed, combined with the ability to overcome greater physical obstructions. The main function of the railway is then to connect centers of population with one another and with the waterways. These two means form but parts of an harmonious system which are interdependent.

As in railways, the measure of the capacity of a line is that of its point of greatest resistance, so in waterways the same principle obtains, and the traffic of a through line is regulated by that where the least draft is to be found. Thus for ocean travel the tonnage and draft of the vessel is generally regulated by the depth of water over the outer bar at harbor entrances, where the greatest obstructions are to be found; in river navigation, traffic may be entirely obstructed by a serious shoal, the removal of which may open up many miles of water transportation; and in canals the through traffic will be determined by the water available for the summit level. For many years the upper lake tonnage was restricted by the St. Clair Flats and the size of the lock chamber at the Sault Ste. Marie Canal. So the Five-Mile Bar in the Delaware is the practical limit of deep water navigation. Were it removed, 24 miles more of the river, having nearly 18 feet at low water, could be made available.

To determine the lines of least resistance, or of least cost, for

the United States, it will be necessary to consider its topographical features and form, with reference to the most direct lines to tide water, the relative cost of movement by rail and water, and the distribution of population.

The United States may be said to be surrounded by water with the exception of that portion of the northern boundary extending from The Lake of the Woods to Vancouver's Island, a distance of about 1,300 miles, and of the southern boundary from El Paso Del Norte on the Rio Grande to the Pacific Ocean, a distance of about 670 miles. The Pacific coast line embraces in round numbers 1,500 miles; the Rio Grande, which is not navigable because of the bar at its mouth and its numerous shoals, 850; the Gulf coast, 1,500 miles; the Atlantic, 2,000, and the Lakes and Erie Canal 1,500, so that out of a total of 9,300 miles about 6,500, or 70 per centum, are navigable.

It is not proposed at this time to compare the relative advantages of the Atlantic and Pacific harbors, but to call attention more particularly to the facilities afforded by the northern and southern water frontages, so to speak.

The northern or Lake system extends from New York, via the Hudson River and Erie Canal, to Buffalo 502 miles, and thence about 1,000 miles to the heads of Lakes Michigan and Superior, where are to be found the natural centers of distribution and trans-shipment. The tributary areas of these two points will be found by drawing a perpendicular to the chord joining them at its middle point. This dividing line, extending in a south-westerly direction, will be found to pass through Iowa, Nebraska, Kansas, the northwest corner of the "Pan Handle" of Texas and New Mexico; and hence it appears that for the great grain, mining and cattle industries of the Northwest the head of Lake Superior has the advantage over that of Lake Michigan by 400 miles, or less according to the latitude. The present depth of the Erie Canal is but seven feet. Hence, for foreign or coastwise traffic there must be three trans-shipments, viz.: at the port of clearance, at Buffalo and at New York or Montreal. The ruling depth on the Upper St. Lawrence is nine feet. This northern or lake route is also closed for about five months of the year, yet the tonnage through the Sault Canal to Lake Superior alone, during the

season of navigation, is now at least equal to that through the Suez Canal during the entire year. By this water route the territory of the Lake Basin is enabled to secure the benefit of competitive rates.

On the southern boundary there is the Gulf of Mexico stretching for 1,500 miles from Key West to the Rio Grande, into which empties a system of rivers extending over thousands of miles of the great central basin, and reaching to within 30 miles of the northern system at Chicago. Recently the barrier separating the rivers from the Gulf was removed by the completion of the South Pass jetties, giving 30 feet of water instead of eight. The Gulf and the southern rivers do not freeze in winter so as to prevent navigation, and the only serious difficulty arises from the bars at the outlets of the rivers and bays emptying into the Gulf. With the exception of Pensacola and the South Pass there are no entrances in this long stretch of coast line having over $12\frac{3}{4}$ feet of water over the bar, and hence they are cut off from all other ports from which deeper draught vessels depart. In consequence, the commercial interests of this coast and the country tributary thereto have been but little developed, notwithstanding its greater advantages.

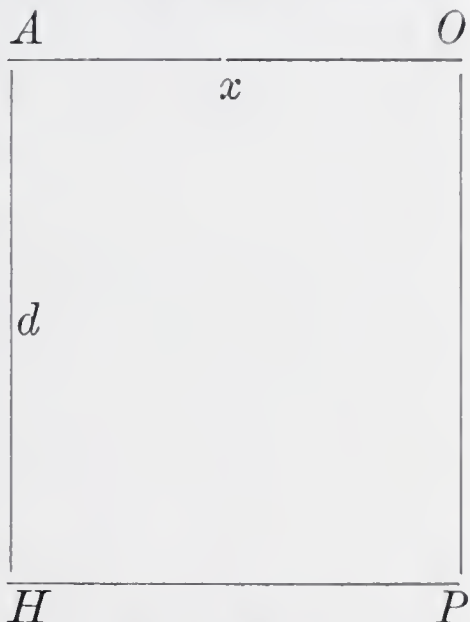
The east and west movement of the higher latitudes has no counterpart on the Gulf, yet it is often urged that the natural outlet for cereals and articles in bulk is down the Mississippi to the Gulf, and thence to the markets of the world.

Several reasons may be assigned for this; the first has been suggested already, namely, lack of sufficient depth of water; the second is the time required to make the trip. For whilst the distance from the mouth of the Ohio to the Pass along the axis of the river is about 630 miles, the distance by the channel is 1,130, or 80 per cent. greater, so that if the barges were to make the same velocity as the freight trains, it would require nearly double the time to reach tide water, and even then there would be but little, if any, gain in the direction of the ultimate market, which may be north or east.

It is also stated that in passing through the warmer latitudes the cereals germinate and become worthless. Whilst these objections may apply to some of the products of the upper country,

they cannot be made to include those of the Southern States, as cotton, sugar, tobacco, cattle, etc. For the northwestern section and for the central belt of country lying west of the Mississippi, it would appear to be of great importance to construct the connecting water link between the great lakes and the Mississippi basin, and for the central and southern sections to complete the opening up of one or more deep water harbors for that section of the country not tributary to the Mississippi.

To determine the limit and extent of this territory, we may take the relative rates already cited, and, having the developed distance, may find the locus of the points of equal cost by rail direct to the river and thence to the Gulf; or, by rail direct to the Gulf. Thus let A be such a point, x , A O its distance from the river, $=(A O)$ and d its distance from the Gulf ($A H$). The rail rate is 3.3 times that by river and the distance ($O P$) by the latter channel is 80 per cent. greater in consequence of the meanders, hence $O P=1.8d$. The equation of rates will then be $1.8d+3.3x=3.3d$, or $x=\frac{1}{2}d$, which is the equation of a right line, the tangent of whose angle is $\frac{1}{2}$. The angle is therefore $26^{\circ} 34'$.



Taking the 91° of longitude as the meridian of the Mississippi Valley, and drawing these two radii from its intersection with the Gulf, it will give the sector of country which is theoretically tributary to the Mississippi. Practically this sector is modified and limited by intersecting water courses in other directions, which would change somewhat the form of its boundaries.

The northern limit will be reached at or near the 40th parallel of latitude, from which, rates only being considered, it will cost the same via the lakes or the river to tide water. This transportation "divide" separates the territory into the grand divisions of lake, river and railroad.

At the existing relative rates the areas of these several divisions are:—

For the Mississippi River basin	about 300,000 square miles.
That tributary to the Great Lakes	“ 500,000 “
The Atlantic Coast, escarpment	“ 550,000 “
The Great South-Western, Gulf slope,	“ 1,000,000 “
The Pacific area	“ 700,000 “

In all of these the railroads play an important part and carry the volume of the traffic. Their general directions should therefore converge towards the principal ports. This would bring the trunk lines of the Texas district south, south-east and east, with connecting laterals. The more the commercial facilities by ocean are developed the greater will be the volume of business brought to the railroads. Thus an average ocean “tramp” of 2,000 tons net would supply loading both ways for about one hundred cars, but if there is no landing for the vessel it cannot bring the traffic. It is an old maxim in transportation that *facilities beget traffic*.

The area tributary to the Gulf is larger than any other, and is the least developed because of its comparative isolation. It embraces the larger part of that portion of the federal domain lying west of the river territory, which is also dependent upon railroads for the transportation of its products to tide water. To determine these subdivisions into northern and southern areas, let a line be drawn from Superior to Galveston, and bisect this chord at its middle point. This gives a line near the 39th parallel, which is also that of the centre of population. But as the northern water route is closed five-twelfths of the time, requires two trans-shipments in excess of the southern route, and is a cross country instead of a down grade line, the practical position of the divide would be shifted much farther north, and may, I think, reasonably be placed about the northern boundary of Colorado. Thus it will be seen that, although the air line distance from Denver to Superior is less than to the Gulf, there are other physical as well as commercial considerations which would make the latter route the better one.

The location of Denver as a transportation centre is strategic, for if a circle be described about it with a radius extending to Chicago, it will include a large part of the Mississippi River, touch the Gulf coast between Galveston and Aransas Pass, the Pacific

Ocean from Point Conception to Lower California and pass through the Bay of San Francisco. The most accessible water frontage is found on the Gulf, which is therefore the nearest eastern shipping port for the vast territory included in Texas, New Mexico, Arizona, Nevada, Utah, Colorado and parts of Nebraska, Kansas, the Indian Territory and Mexico, and embracing nearly or quite 1,000,000 square miles or 640 million acres. It is a magnificent empire awaiting the completion of the government works to secure deep water at some one or more passes on the Texas coast.

This being accomplished, there will be a rapid development of railroad construction in this section, radiating from the Gulf to the Northwest, and a great impetus to manufactures, agriculture, irrigation works and the numerous industries accompanying the providing of facilities for cheap transit.

Texas is the door, but time has locked and barricaded it with sand, which, thus far, the efforts of man have been unable to open and remove. This is one of the most important problems of the future. So important has it become that the people of this section of the country have called a general convention to meet at Fort Worth, Texas, on the 10th of July next, to discuss and consider the question of creating a deep water harbor at some point on the Gulf coast, west of the South Pass. It is a subject of great interest to all departments of engineering, and hence I have taken the liberty of inviting your attention to it.

